



## ORIGINAL RESEARCH PAPER

Education

### EFFECTIVENESS OF STEAM-BASED PROGRAMME ON STUDENTS' CONCEPTUAL UNDERSTANDING.

**KEY WORDS:** STEAM, conceptual understanding, science education, experimental research

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#### ABSTRACT

This study investigates the impact of a STEAM-based instructional program on the conceptual understanding skills of secondary school students. Using a pre-test, post-test experimental design, 72 Class 9 students from a secondary school in Gujarat were divided into experimental and control groups. The experimental group received instruction through the STEAM framework, while the control group followed traditional teaching methods. Pre- and post-tests measured the students' conceptual understanding abilities. Results analyzed using the Mann-Whitney U Test showed significant improvements for the experimental group. These findings highlight the potential of STEAM education to enhance deeper learning in science. The study suggests that integrating STEAM into school curricula can foster essential 21st-century skills.

#### INTRODUCTION

The rise of digital technologies and the increasing importance of interdisciplinary knowledge have prompted educators to seek innovative ways of teaching. One such approach is STEAM (Science, Technology, Engineering, Arts, Mathematics), which integrates disciplines to foster creativity, critical thinking, and problem-solving. While traditional teaching methods often focus on rote memorization, STEAM emphasizes inquiry-based learning that promotes a deeper understanding of concepts. This study aims to evaluate the effectiveness of a STEAM-based program in enhancing students' conceptual understanding compared to traditional teaching methods.

Between 2011 and 2021, various studies examined the impact of technology-integrated and STEAM-based education on student learning outcomes, especially in developing computational and critical thinking skills. Early studies, such as by Games et al. (2011), demonstrated that digital game-based learning could enhance logical thinking and problem-solving skills among middle schoolers in Taiwan. Other studies, like those by Bani-Matar (2014) and Bers and Sullivan (2014), highlighted how technology tools like GeoGebra and robotics could aid abstraction and computational thinking in young students.

Later research focused on integrating STEAM approaches in educational programs. For example, Bati et al. (2018) created a STEAM-based Time Teaching Program in Turkey to improve computational thinking, while Kotzampasaki and Psycharis (2018) used Arduino-based educational games to boost these skills in Greek students. Ergün and Külekci (2019) and Rahmawati et al. (2019) explored STEM's influence on perceptions of engineering and technology, as well as critical and creative thinking skills.

Recent studies like those by Chung et al. (2020), Gencer and Dogan (2020), and Kartika et al. (2021) focused on enhancing STEAM competencies and critical thinking through specialized curriculum, digital platforms, and the integration of imagination in design-based learning. Lastly, Twiningsih and Elisanti (2021) developed a STEAM-based thematic media that successfully improved critical thinking and scientific literacy among elementary students.

Overall, these studies underscore the positive impact of STEAM and technology-integrated approaches on students' computational, critical thinking, and problem-solving skills.

#### Objectives Of The Study:

1. To develop the STEAM based Programme for the selected units of standard nine science subject.
2. To develop Conceptual understanding test to measure the Conceptual understanding of students.
3. To study the effectiveness of STEAM based Programme compare to traditional method on Conceptual understanding on students.

#### Research Questions:

1. What is the students' respective levels of conceptual understanding before and after STEAM based Programme?

#### Hypothesis Of The Study:

1. There is no significant difference between the mean of pre-test score in conceptual understanding test of experimental group students and control group students.
2. There is no significant difference between the mean of post test score in conceptual understanding test of experimental group students and control group students.
3. There is no significant difference between the mean of gain score in conceptual understanding test of experimental group students and control group students.
4. There is no significant difference between post test score in conceptual understanding test of experimental group's girls' and boys' students.
5. There is no significant difference between gain score in conceptual understanding test of experimental group's girls' and boys' students.

#### Definition Of Key Words

##### Steam Based Programme:

STEAM represents a paradigm shift from traditional education philosophy, based on standardized test scores, to a modern ideal which focuses on valuing the learning process as much as the results. In essence, we dare our students to be wrong, to try multiple ideas, listen to alternate opinions and create a knowledge base that is applicable to real life as opposed to simply an exam.

STEAM Education is an approach to learning that uses Science, Technology, Engineering, the Arts and Mathematics as access points for guiding student inquiry, dialogue, and critical thinking. (Susan riley, arts integration specialist)

The researcher is prepared STEAM based programme will include following each step Focus, Detail, Discovery, Application, Presentation, Link.

### Effectiveness:

According to **Annual report** (2004), 'Effectiveness' farers to "the extent to which actual out comes, via relevant outputs, programmes or administered expenses. The effectiveness of an output or program should be distinguished from its efficiency, which concerns the adequacy of its administration.'

According to **Wikipedia Encyclopedia** (2008), Effectiveness means the capability of producing an effect."

In presence study the significant difference between experimental group post-test mean and control group post-test and gain score mean is consider as an Effectiveness of the programme.

### Conceptual Understanding:

According to Tan and yangco, One Important aspect of conceptual understanding is its capacity to promote retention of lessons learned.

The scores obtained by the students on the conceptual understanding test develop by the researcher is consider as a Conceptual Understanding.

### Variables Of The Study

No.	Type of Variable	Name of Variable
1.	Independent variable	1. STEAM based Programme 2. Traditional Method
2.	Dependent variable	1. Conceptual Understanding
3.	Controlled variable	1. Standard - 9 2. Subject - Science 3. Unit - Selected unit 4. Medium - Gujarati 5. Duration of study
4.	Intervening variable	Atmosphere, interest, enthusiasm, curiosity, understanding, intelligence, interaction, etc.

### Population And Sampling:

This study employed an experimental research design, using a sample of 72 Class 9 students from Shri B. L. Patel Sarva Vidyamandir, Rankuva. The students were randomly assigned to either an experimental group (n=36), which received STEAM-based instruction, or a control group (n=36), which was taught using traditional methods.

### Research Method:

In the present study Experimental research design is used as a true experimental design Two Randomized Groups, Pre-Test Post-Test Design. (Shukla, 2018, p.751).

$$E_r \quad T_1 \quad XT_2$$

$$C_r \quad T_1 - T_2$$

### Data Collection

For data collection, permission was obtained from the principal of Shri B. L. Patel Sarva Vidyamandir, Rankuva, to conduct the study. A pre-test was given to both the experimental and control groups from Class 9. The experimental group was taught the science topics "Sound" and "Work, Energy, Power" using a STEAM-based program, while the control group received traditional instruction. After the lessons, a post-test measured the students' academic achievement based on these teaching methods.

### Technique Of Data Analysis

In the present research, the U-value was calculated using the Mann-Whitney U Test based on the pre-test, post-test, and gain scores of the students. (Parekh & Trivedi, 1994)

### Table - 1

#### Effectiveness Of "Steam" Programme

Hypothesis	Group	N	Rank Average	Sum of Ranks	U	Z	P	Significance at the 0.01 level
H <sub>01</sub>	Experimental	36	35.33	1272	606	0.46739	0.63836	The result is not significant
	Control	36	37.67	1356				
H <sub>02</sub>	Experimental	36	52.86	1903	59	-6.62786	<0.0001	The result is significant
	Control	36	20.14	725				
H <sub>03</sub>	Experimental	36	52.99	1907.5	54.5	-6.67854	<0.0001	The result is significant
	Control	36	20.01	720.5				
H <sub>04</sub>	Experimental Girls	23	33.37	1535	144	2.82548	0.00466	The result is significant
	Experimental Boys	13	18.08	235				
H <sub>05</sub>	Experimental Girls	23	18.83	433	142	0.23054	0.8181	The result is not significant
	Experimental Boys	13	17.92	233				

### RESULTS:

- 1) There was no significant difference in pre-test scores for conceptual understanding between the two groups, indicating they were comparable before the experiment.
- 2) The experimental group significantly outperformed the control group in the post-test scores for conceptual understanding.
- 3) The experimental group showed a significantly higher gain in conceptual understanding scores compared to the control group.
- 4) There was a significant difference in post-test scores within the experimental group, with girls outperforming boys in conceptual understanding.
- 5) There was no significant difference in gain scores between boys and girls within the experimental group, suggesting that both genders benefited equally from the STEAM-based instruction.

### CONCLUSION:

The study concludes that STEAM-based education significantly enhances students' conceptual understanding. Educators should consider integrating STEAM into their curricula to promote deeper comprehension of science subjects. Future research could explore the long-term impact of STEAM on other disciplines and across different educational settings.

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